Can Pre-harvest Marketing Strategies Increase Net Returns for Corn and Soybean Growers?

by

Robert N. Wisner, E. Neal Blue, and E. Dean Baldwin

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Abstract

Grain producers price grain prior to harvest to reduce financial risk and to enhance net returns. Since accomplishing the second objective is debatable, alternative corn and soybean pre-harvest options/hedge marketing strategies were designed to test the hypothesis that pre-harvest pricing could generate statistically higher average net returns than harvest sales, without increasing income variability. Weekly seasonal futures price patterns from 1975 to 1994 were used to time marketings. The strategies were applied to Iowa and Ohio model farms. For the 1985-96 period, the hypothesis was accepted.

Introduction

In the 1960s, Cootner and Samuelson popularized the Random Walk Theory (RW) and the efficient market hypothesis (EMH). These imply that prices fluctuate randomly about their intrinsic value and at any point in time, reflect all available market information. The concept was initially applied to stock markets which, unlike grain, are not influenced by seasonal weather. It implies that the optimum investment strategy is to buy and hold an index of stocks rather than timing investments to beat the market (Murphy). Application of EMH and RW to agricultural futures markets supports harvest sales or risk-reduction hedges. Other studies have advanced the debate as to whether pre-harvest marketing strategies using hedges or options can increase grain producers' profits above those from naive, harvest-time cash marketing. This paper examines alternative corn and soybean pre-harvest marketing strategies, and tests the hypothesis that a set of pre-harvest strategies can generate statistically higher average net returns than harvest sales. Simulated returns over variable costs are generated for model farms in Iowa and Ohio, using grain market data and yields for 1979-1996. When options are included, 1985-1996 data are used.

In the analysis, we categorize marketing years by size of the U.S. crop relative to utilization. This is done, not with anticipation that short crops can be forecast ex ante, but to identify different pricing strategies to be used in years following short crops than in

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years of near normal crop yields. This categorization also allows visualization of potential gains from use of options markets, which retain upward price flexibility. Our definition of short crop years is as follows: $P_t < U_{t-1}$, where P=U.S. production and U=total utilization. This definition may differ from others that are based on deviations from trend yields. Its purpose is to identify years when old-crop market functions shift to a demand-rationing mode and new-crop futures (year t+1) encourage expanded production. Other years are classified as normal-crop years, with a subset called years following short crops, or short crops ex post. This paper examines seasonal price patterns and compiles potential returns from marketing strategies that are triggered by average seasonal price movements.

For grain farmers, some costs of production may be made years in advance. Most remaining costs are disbursed in the spring. To commit major costs without a known selling price and consideration of production risk is a speculative position. In the next section, risks with the speculative harvest sales strategy are examined. Prior to 1996, government target prices reduced price risk exposure for producers selling at harvest..

Pre-harvest Pricing Environment

The 1975-96 period was selected for seasonal analysis because it reflected a global market and unstable U.S. weather, in contrast to much more stable weather and a largely domestic, government controlled grain market of the 1950s and 1960s. The years, 1973 and 1974, were excluded since they represented a learning period in which the grain trade adjusted to dramatically changed market conditions. During 1975-1996, and 1911-1996, normal crop years occurred 76 and 77 percent of the time, respectively.

For normal crop years of the study period, Thursday's closing new-crop December corn futures prices from early January before harvest to harvest time traded in an average high-low range of $0.54 per bushel, with the harvest price almost always being the low. Annual extremes in high-low ranges from pre-harvest to harvest (excluding 1975) ranged from $1.10 above to only $0.26 per bushel above the harvest price. In 80 percent of the normal crop years, the pre-harvest new-crop price fluctuations exceeded the harvest prices by $0.40 or more per bushel. Price highs—except for 1975— exceeded the harvest price and occurred well before harvest. The peak usually occurred before mid-July. Thus, pre-harvest futures prices were not good indicators of actual harvest prices in a given year.

Figures 1 through 4 show new-crop corn and soybean futures price changes by year for normal and short crops, from spring to fall. We highlight spring premiums over fall prices because of their persistence over a large number of years. Student t tests indicate the spring new-crop futures for normal corn and soybean crop years in this period were significantly different from harvest prices at the 2.7% and 1.9% levels, respectively. ***The difficulty with routine springtime hedging with new-crop futures is that prices rise sharply during short crop years, generating losses on futures positions.*** In the six short-crop years of this period, corn prices increased by an average $0.25 per bushel from the first week of July to the first week of November (Figure 3). ***Harvest cash marketings perform well in short-crop years, if the producer is not in the area of crop losses that is driving the market. In other years, cash marketers may face low prices and cash-flow pressures.*** With options markets and the short-crop ex post classification, we find that certain pre-harvest strategies have captured part of the price increase that occurred during the 24 percent of time accounted for by short crops.

In the short crop ex post years, December corn and November soybean futures were lower at harvest than in late winter before harvest (Figures 5 & 6). December corn futures prices in late February prior to harvest averaged $0.39 per bushel above the December futures price in early November. Based on the t-test, these differences were significant at the 6.4% level. New-crop November soybean prices in February before harvest averaged $1.00 per bushel above the November futures price in mid-October. These differences were statistically significant at the 1.81% level. Price patterns for these three categories of years are the foundation for the creation of pre-harvest marketing strategies tested here.

Literature Review

Working and Telser searched for a risk premium in post-harvest grain futures markets and found none. Instead, they found a convenience yield that influenced the price of storage and old-crop futures price spreads. The focus here is on pre-harvest pricing of corn and soybeans, rather than on post-harvest markets and storage returns. Much work on pre-harvest pricing has centered on minimizing the variability of producer income through optimal or minimum-variance hedge ratios (MVHs) (Benninga, *et al.*; Baillie and Myer; Fackler and McNew; Lence, *et al.*).

Tomek and other researchers have examined the forecasting ability of futures markets. Tomek concludes that forecasts developed by quantitative models are unable to do better than efficient futures as forecasting agents. At the same time, futures prices can be efficient in reflecting complex information into prices and still be poor forecasters. The brief review of new-crop corn and soybean futures prices above indicates that in any given year of our study period, spring and early summer futures prices had wide divergence from actual harvest-time prices, and in a majority of years, exceeded harvest prices. Other research addressed market efficiency and risk premia questions (Kastens). Fama was unable to reject the random walk hypothesis. Several studies show evidence hinting of possible risk premia or short-run price persistence in certain commodity futures markets (Stevenson and Bear; Cootner). Other work shows evidence of risk premia in exchange rate and financial futures markets (Bessembinder; Bessembinder and Cahn;Junkus).

R.W. Anderson researched volatility in 160,000 price observations with an assortment of commodity markets including corn and soybean futures. He found that variance, and hence, volatility of futures prices varies with the magnitude of supply-demand uncertainty, and has strong and recurring seasonal patterns. ***"The fact that there is seasonality in the volatility of futures prices in markets with annual harvests will hardly come as a surprise to those familiar with the fundamental factors of supply and demand in those markets. However, these important seasonal factors have been overlooked in previous studies of the volatility of futures prices which have been concerned with the effect of changing time to maturity," (p. 345). Anderson found that volatility of corn and soybean futures prices peaks in June and July, and declines into fall.*** This has implications for options and possibly futures markets. In financial literature, the Capital Asset Pricing Model indicates market portfolio risk is measured by variance of returns, with risk premia tending to increase as variance increases (Engle, *et al.).* In analyzing one-week time cells from October 1972 through September 30, 1989 in corn, soybean, and Chicago wheat futures markets, Stevens found statistically significant evidence of short-term, weather-related persistence in corn and soybean futures prices that might cause temporary deviations from a random walk.. This effect was greatest for corn in mid- and late February, June, and July. For soybeans, the periods showing greatest frequencies of price persistence were late January, early February, May, June, and July.

Curtis, *et al.* developed a target motad model of options and futures pricing strategies that triggered sales when target income levels and variability objectives were reached, based on seasonality of post harvest futures.They demonstrated that certain futures pricing strategies have a potential to enhance producer incomes with little change in variability of income. Pfeiffer, Sandell, and Kendrick extended the range of alternatives to pre-harvest pricing and found opportunities to stabilize and enhance income through spring and early summer pre-harvest pricing with soybean futures and options. They concluded that income-enhancement opportunities were greater from pre-harvest than through post-harvest pricing. Monson and Hayenga in simulation models of 250 Iowa farms for 1980-1989 found average increases in corn and soybean gross revenues of 3 to 4 percent and 9 percent, respectively from harvest prices, using optimal hedge ratios. Percentage increases in net revenue would be considerably larger.

Carter, Rausser, and Schmitz used agricultural futures in portfolios of commodities, and found evidence that risk premia do exist in commodity futures markets. Hauser and Eales tested nine strategies for options and futures hedging, comparing results with unhedged cash marketings. Their work suggested put options provide a favorable hedge when yield uncertainty is high. Plato found that options strategies reduced the standard deviation of producer income per acre. Leeds, *et al.*, found that the corn basis tends toward mean-reversion. However, Irwin's later work casts doubt on mean reversion in corn and soybean futures prices. Mean reversion may be at work in the results reported here, but in a different context than analyzed by Irwin. Lapan, *et al.*, and Vercammen examined theoretical implications with options pricing when price distributions are skewed, production is variable, and hedgers maximize utility.

Wisner (1991) segregated corn marketing years into three types noted above. He calculated returns from strategies using late February hedges for short crop ex post years, with options and hedges for other years and market timing coinciding with average seasonal price peaks in normal-crop years. Use of options at planting time provided upward price flexibility in case a short-crop year occurred. Modest early July hedging positions added to average net income and provided less exposure to futures losses than planting-time hedges. Options were closed early to conserve time value.
Results showed substantial increases in average income over variable costs vs. harvest cash marketings for Iowa and Nebraska locations, with little change in income variability. Using a t test, Wisner (1997) found pre-harvest pricing returns for northwest Iowa with combinations of futures and options for the 1979-96 crops that were significantly different from harvest cash marketings at the 2.8 percent level of probability. Zulauf (1996) concluded that no incentive for pre-harvest pricing exists. Alexander analyzed pre-harvest corn and soybean strategies for model farms in Ohio. He did not include combinations of futures and options pricing strategies; instead each was considered separately. Further, no adjustment was made for years following short crops, and options positions were not closed early to recapture time value. Using t tests, he rejected the hypothesis that returns from pre-harvest pricing were significantly different from harvest cash marketings.

Previous work on futures and options markets has not fully resolved issues related to risk premia or seasonal weather influences on new-crop futures price volatility. For the most part, empirical work has not included mixed hedging and options pricing strategies in the same crop year. Most work has not dealt with differences in seasonal price patterns for new-crop futures in years following short crops. This study incorporates these features.

Focus of this Study

A hypothesis tested here is that a set of pre-harvest marketing strategies can generate statistically higher average net returns than the naive harvest sale strategy, with little increase in variability of the returns. Net returns from 10 pre-harvest marketing strategies were generated, and were tested for statistical difference from the naive strategy, using a t test. For the normal crop years, as noted earlier, new-crop futures prices for both corn and soybeans were near their average highs from May through July. The observed highs represent a premium over harvest prices and may reflect uncertainties in domestic and foreign production prospects. As production prospects become more certain, prices decline into the harvest period. For most strategies and most years, puts and synthetic puts were used to capture part of the upward trending price movement that occurred 24% of the time. These strategies also protected against sharply declining new-crop prices. In short-crop ex post years, average new crop corn and soybean futures prices approached their highs during February and later declined into the harvest period (Figures 11 and 12). New-crop prices in short-crop ex post years are relatively high to stimulate an increase in plantings and rebuild inventories. Producers respond and futures prices trend downward.

Decision Rules Underlying Marketing Strategies

See Table 1 for marketing decision rules. Since rational producers would attempt to price grain at or near the average highs, hedge positions were placed routinely in the first week in February after short crop years. Two rules were used for all other years. The

Table 1. Pre-harvest Marketing or Trading Strategies for Corn and Soybeans[1]

Strategies	*Decision Rules for Strategies*
General	*All short futures hedge positions are offset during the second week of October for soybeans and fourth week of October for corn.*
Hedge I	*Hedge first week in February following short crop year; otherwise hedge during the third week of May.*
Hedge II	*Hedge first week in February following short crop year otherwise hedge during the first week of July.*
Synthetic Put I	*Hedge in February following short crop year; otherwise hedge during third week of May and buy \$0.20 (\$0.25) out-of-money new crop corn (soybean) call which is offset in July Week 1*
Synthetic Put II	*Hedge in February following short crop year: otherwise hedge during third week of May and buy \$0.20 (\$0.25) out-of- money new crop corn (soybean) call which is offset in August Week 1*
Synthetic Put III	*Hedge in February following short crop year; otherwise hedge during third week of May and buy \$0.20 (\$0.25) out-of-money new crop corn (soybean) call which is offset in September Week 2*
Synthetic Puts IV- VI	*Repeat rules for synthetic puts I - III, but eliminate February hedge following short crop year*
Mixed Hedge/Put I	*Hedge in February following short crop year: otherwise buy \$0.20 (\$0.25) out-of-money new crop corn (soybean) put for 80% of expected production in third week of May and hedge remaining 20% of expected production in July. Offset put in October week 2.*
Mixed Hedge/Put II	*Hedge in February following short crop year: otherwise buy \$0.20 (\$0.25) out-of-money new crop corn (soybean) put for 80% of expected production in third week of May and hedge remaining 20% of expected production in July. Offset put in September[2].*

1. For Hedge I and II strategies, 1979-1996 was analyzed to correspond to Wisner's previous work. With options strategies, the analysis period was 1985-1996, to avoid artificially generating options premia.

2. A range of 50 to 80 percent of the 10-year moving average production covered by puts was tested. Highest net returns occurred with puts purchased in May covering 80 percent of indicated production, with the remaining 20 percent hedged in July with November or December futures. Any unhedged production was sold in the harvest cash market.

short hedge positions were placed in either (1) the third week of May or (2) the first week of July (Hedge I and Hedge II strategies). Following Wisner's previous work, net returns were analyzed for 1979-1996 for the hedge strategies. With Synthetic Put I-III strategies and mixed hedge/put strategies, these short hedging rules were also followed. For the Synthetic Put IV-VI strategies, the February short hedge rule was eliminated. All short hedges were placed during the third week of May for synthetic put IV-VI strategies, and the previously purchased call options were sold at varying times.

Synthetic puts and mixed hedge/put strategies were created by buying either out-of-money calls or puts during the third week of May for all crop years. Because of differences in seasonal price volatility and hence in the time value component of premiums, the calls were offset in three alternative months to evaluate impacts on net returns. It is well-known that in grain options, time value drops sharply in the last two months of trading. The options were closed early to avoid a sharp decline in this component of value. The temporary use of calls gave upward price flexibility after hedging during the period when crop prospects and hence price prospects were most uncertain. With this process, six synthetic put strategies were created. It was hypothesized that the observed increase in price volatility in July would generate higher net returns for offsetting calls in July than in either August or September. The hypothesis was accepted.

Data and Simulation Model

To test the net-returns hypothesis, two model farms were simulated, one for northwest Iowa and one for Ohio (Table 2). The two farms capture effects from differences in yield levels and variability. Each had 1,000 harvested acres, half in corn and half in soybeans. Costs were from Extension budgets. O'Brien County, Iowa and Ohio state level yields were used (Iowa Dept. Of Agr. and Land Stewardship; Iowa State Univ.; Ohio Enterprise Budgets; and Ohio Agr.Stat and Annual Reports).

Production, and Execution of Market Positions

Production levels for marketing purposes are based on the prior 10 year rolling yield averages (Table 2). Hedges and options positions were executed up to the highest integer level not exceeding the expected production, using 5,000 bushel contracts. With upward trending yields, this procedure provided a cushion to help avoid being oversold in years of short crops. When an oversold position occurred, the excess was bought back at the harvest futures price (the second week of October for soybeans and for the fourth week of October for corn). All cash transactions were made at these same times.

Prices, Option Premia and Other Data

For the pre-harvest marketing strategies, closing Thursday cash, futures prices and options premia were used. Cash prices were averages paid to farmers in northwest Iowa and at ten Ohio elevators (Baldwin and Dayton). If the markets were closed on Thursday, we used the preceding Wednesday's prices. Local basis patterns were used. Round turn brokerage fees of \$40 and \$60 were charged for futures and options accounts, respectively, and a 7% initial margin was used for futures. Interest for investments in hedge-related costs and option premia were charged at the annual prime rate plus 1 percent. When futures profits were generated, the prevailing three month U.S. Treasury bill rate was credited to the account. Futures were marked to market each week, and maximum account draw-downs were recorded weekly.

Results

For the 10 pre-harvest marketing strategy simulations, means and variances of net returns were compared to the naive cash marketing strategy. Following prior studies, a t test was used to determine whether net returns were statistically different from the naive strategy. Where appropriate, the results are analyzed from a farm perspective to demonstrate how strategies affect the total farm business. Differences between Ohio and Iowa farms are noted. ***As a precursor to the results discussion, note that the pre-harvest strategies would not prevent storage. Note also that no call sales or exposure to spread risk such as involved in multi-year HTA's existed with these strategies.***

Soybeans

The best-performing soybean pricing strategy, based on statistical significance and mean return over variable costs, was the Synthetic Put IV. Synthetic puts were created by simultaneously placing a November new-crop short hedge and buying a \$0.25 out-of-money November call during the third week of May. Purchasing the call retained upward pricing flexibility during the period of greatest uncertainty in the production cycle. Calls were offset in July since holding them longer reduced time value and net returns. Once that period of uncertainty was completed, history showed relatively little need to retain the calls. ***After sale of the calls, price protection was retained by the hedge.***

For Iowa's model farm, the average net annual returns from this strategy ***exceeded returns from the naive marketing strategy by \$7,282 at a significance level of 1.1%. Ohio average net annual returns were increased by \$6,600 with a significance level of less than 1%.*** Thus, the hypothesis that this strategy **would increased net returns** was accepted. Higher soybean yields in Iowa generated greater net returns relative to the Ohio model farm. Differences in yields and basis between the two states may also explain differences in the variance and coefficient of variation of returns.Variation in net returns, by both measures, is lower for Ohio (STD = \$11,318 and CV = 0.19) than for Iowa (STD = \$32,757 and CV =0.41). For Ohio, both the standard deviation and the coefficient of variation were smaller for the Synthetic Put IV than for the naive strategy. ***Thus, in Ohio, the pre-harvest strategy increased average net returns and reduced the variation about the mean net return.*** For Iowa, the standard deviation was higher but the coefficient of variation (CV) was lower for the Synthetic Put IV than for the naive strategy. ***Thus, in Iowa, the pre-harvest strategy increased net returns without much change in variance about the mean.*** Since average net returns for

Table 2. Simulation Model for Iowa and Ohio Model Farms.

Expected Production	$E(P_{yr}) = \Sigma_{yr-1}^{yr-10} Y_{yr} * 500$ acres / 10
Number of Futures Contracts (real value)	$E(P_{yr}) /5000$
Number of Options Contracts (real value)	$E(P_{yr}) /5000$
Number of futures contracts (integer value)	$n_f = Int(E(Y_{yr}) /5000)_{floor}$
Number of options contracts (integer value)	$n_o = Int(E(Y_{yr}) /5000)_{floor}$
Transaction Costs	Futures: $TC_F = n_f * \$40$ Options: $TC_O = n_o * \$60$
Margin	$Mg = F_1 * n_f * 7\%$
Marked to Market Gains or losses	$MM_t = -(F_t - F_{t-1}) * n_f$
Interest on Maintenance Margin Short Hedge	
Interest assessed when account is negative	$I_{ct} = (MM_t)_- * (rp_t - rf_t)$
Interest Gained when account is positive	$I_{gt} = (MM_t)_+ * rf_t$
Interest Assessed on the Life of the Option:	$I_o = (n_o * OP_1 * 5000) * (rp_1 * (T - t)/48)$
Account Balance	
Account in Week 1	$Acct_1 = MM_1$
Account in Week 2 to week T-1	$Acct_t = (MM_t + I_{ct} + I_{gt}) + Acct_{t-1}$
Account in Week T	$Acct_T = (MM_T + I_{cT} + I_{gT}) + Acct_{T-1}$
Interest on Initial Margin	$I_{Mg} = ((rp_t - rf_t) * (T - t)/48) * Mg$
Interest on Transactions costs	
Interest cost on TC_F	$I_{TCf} = (rp_1 * (T - t)/48) * TC_F$
Interest cost on TC_O	$I_{TCo} = (rp_1 * (T - t)/48) * TC_O$
Revenue from Futures	$R_F = Acct_T - TC_F - I_{TCf} - I_{mg}$
Revenue from Options	$R_O = (OP_T - OP_1) * n_o - TC_O - I_o - I_{TCo}$
Revenue from Cash Sale	$R_C = y_T * P_T$
Total Variable Costs	$TVC_T = vc_T *$ acres
Net Returns	
Futures Strategies	$TR = (R_C + R_F) - TVC_T$
Synthetic Put and Mixed Hedge/Put	$TR = (R_C + R_F + R_O) - TVC_T$

Where:

P_{yr}, is production in year yr

Y_{yr}, is yield in year yr

$E(Y_{yr})$ is the expected yield in year yr based on the 10 year rolling average yield

n_f, is the number of futures contracts

n_o, is the number of options contracts

$Int(.)_{floor}$, is the integer operator that rounds down to the nearest integer

TC_F, transaction cost for futures

TC_O, transaction cost for options

Mg, is the 7% margin of the value of the initiated futures contracts

t, is the weekly period counter in the hedging season
T, is the final period in the hedging season
F_1, F_t, and F_{t-1} are the futures prices in period 1, period t and period t-1
MM_t is the marked to market gains or losses in period t
rp_t, is the prime rate in period t
rf_t, is the risk free rate in period t
$I_{c\,t}$, is the interest cost assessed on the futures account when it is negative
$I_{g\,t}$, is the interest revenue gained on the futures account when it is positive
$(.)_-$ is a function operator that returns a value when argument is negative
$(.)_+$ is a function operator that returns a value when argument is positive
I_o, is interest cost assessed on the life of the option
OP_1, is the option premium in period 1
OP_T, is the option premium in final period of the option life
$Acct_1$, $Acct_t$, $Acct_T$, $Acct_{T-1}$ this is the running futures account in periods 1, t, T, and T-1, respectively
I_{Mg}, is the interest cost on money borrowed to cover the initial margin
I_{TCf}, is the interest cost on money borrowed to pay futures transaction cost
I_{TCo}, is the interest cost on money borrowed to pay options transaction cost
$T- t$, the number of periods in the hedging season
R_F, revenue from futures
R_O, revenue from options
R_C, revenue from cash sale
P_T, spot cash price at harvest
TVC_T, total variable cost at harvest
vc_T, variable costs per acre at harvest
TR, Total Revenue

Synthetic Puts V and I also exceeded those from cash marketings and were significant at less than a 5% level, the hypothesis was accepted for these strategies. For a number of other pre-harvest strategies, net revenue exceeded the naive strategy, but t tests were above 5% probability and the hypothesis was rejected.

Corn

The best performing corn strategy, based on statistical significance and net return, was the Mixed Hedge/Put II strategy. December futures were sold during the first week in February, in years following short crops. ***This strategy generated greater returns than the naive strategy every year following a short crop, including 1996.*** For other years, $0.20 out-of-money December puts were purchased for 80% of moving average production during the third week of May, and 20% of production was hedged in December futures in July. Puts and futures were offset the second and fourth weeks of October, respectively.

Differing Corn Net Returns Vs. the Naive Strategy, Ohio versus Iowa

Ohio and Iowa mean net corn returns for the 18-year period differed considerably for the naive strategy. One would expect the two means to be similar, and this is the case for the 12-year average, 1985-1996. For the 18-year period, Ohio's mean net returns were $55,125 vs. $49,217 for Iowa. The difference is explained by differences in yields, yield variability, and basis. In 1982, low prices and production shortfalls with the cash strategy generated a $15,162 loss over variable costs for Iowa's model farm, while Ohio net returns were a positive $24,000. Differences for 1993 were similar, although Iowa returns were small but positive. ***These naive strategy results show that low yields and low harvest-time prices can create major cash flow problems for a cash marketer.***

Since only option-based corn strategies were statistically significant at the 5% level, only 12-year pre-harvest results presented here. The Mixed Hedge/Put II strategy generated an average net return of $62,591 for Iowa and $62,284 for Ohio. ***Compared with cash marketings, this strategy increased mean annual net average revenues for Iowa and Ohio by $9,340 and $8,343, respectively. Since these differences were significant at the 3.5 and 3.8% levels, respectively, the hypothesis that the pre-harvest strategy would increase net revenues was accepted.*** The standard deviation and coefficient of variation for Ohio are smaller than for Iowa. This suggests corn production and basis risk are greater in Iowa than in Ohio. For both states, the standard deviations and coefficient of variations for the Mixed Hedge/Put II strategy were near those of the naive strategy. Thus, pre-harvest strategy produced higher returns without increased variability. When the Mixed Hedge/Put I strategy was modeled, revenues were again increased, but at the 9.3% significance level. The hypothesis for this and all other corn strategies were rejected.

Other Observations About the Results

When marketing years are segregated by crop size, there is evidence of repeated seasonal variations in new-crop corn and soybean futures prices during and before the growing season. Pre-harvest pricing with extensive use of options markets showed economically as well as statistically significant increases in returns vs. speculative harvest cash marketings for the period analyzed here. ***The best-performing strategies produced mean annual net returns over variable costs for the 1,000 acre Ohio and Iowa farms that were $14,943 and $16,622, respectively, above those from harvest cash marketings. At the same time, the coefficients of variation were lower for both farms than with the naive alternative, and t tests indicate returns were significantly different from harvest cash marketings at less than the 5 percent level of probability.*** These strategies are simple, straightforward, and easily applied by farmers with moderate marketing skills. Options positions are an important element in generating increased incomes, through their ability to retain upward price flexibility in years when prices rise sharply. Exposure to hedge margin calls was limited by conservative volumes sold and heavy use of options markets, although large margin calls did occur for a time in 1996. Interest costs on hedged positions were minor.

These findings run counter to what would be expect from the EMH and RW. The authors suggest at least two possible reasons for the results. First, the increased income may be associated with changes in the market's preceived probability distributions of yields for individual years as the planting and growing seasons progress and more information becomes available relative to probable yields for the specific crop, as well as for domestic and foreign substitutes. Second, the results may reflect Grossman and Stiglitz' hypothesis that costs of acquiring and interpreting information slow price adjustments, with the market not yet having detected arbitrage opportunities.

For a longer look at short-crop ex post years, we examined futures prices since early years of trading. The only short-crop ex post years with higher fall new-crop corn prices than in late winter or spring since 1912 were the start of World War I (1914), the Korean War (1951); and 1975, with highly unusual world economic conditions. Since November soybean futures started in 1937, prices from winter and/or spring to fall in such years reveal only two exceptions (1941 and 1954) to the downward trend. Average winter-to-fall hedge gains were 13 and 12 percent, respectively, with significant differences vs. harvest prices at less than one-tenth percent probability levels using the t test.

Areas for Further Research

Other new-crop pricing strategies could be tested using this framework, including options fences with alternative out-of-the-money call sales. Conversion of fences to hedges in July could be considered. Rolling new-crop options to successively higher strike prices on rising markets may also merit consideration. Analyzing farms in other geographic areas, and with irrigated crops may prove useful for extension work. Storage alternatives could be added. Work on seasonal volatility of corn and soybean futures prices and its relation to options premia could be useful. Tests for normality in the distribution of spring-to-fall futures price changes and further work on mean-reversion tendencies for the spring-to-fall time period seems appropriate. It might be fruitful to compare fall harvest price distributions implied by spring options markets with the longer-term distribution of actual harvest-time futures prices. Nonparametric statistical tests and tests for existence of seasonal risk may be appropriate.

Final Comments

For the years analyzed here, certain pre-harvest strategies could have helped to manage risks while increasing profits. We do not conclude that the corn and soybean markets are inefficient. Rather, we suggest that a careful look at market functions is in order, as well as an examination of changes in the set of information that is available as the planting and growing seasons progress. The concept of returns which vary with seasonal changes in perceived production risk may be at work here. It should also be recognized that wide dissemnation of this information may change price behavior. Thus, past market performance does not guarantee future performance. Nonetheless, the analysis shows justification for encouraging producers with moderate marketing skills, and willingness to use options to carefully develop marketing plans using good estimates of production costs, living expenses, returns to assets, and strategies for managing production risks, in order to identify "acceptable" ranges of prices. These price ranges can then be compared to prices available through futures and options markets. Patterns identified here show frequently higher spring and early summer new-crop prices than those at harvest. Producers should also be aware that inadequate attention to yield risk combined with poorly organized and poorly planned marketing strategies, can add to risk, as in other farm management decision areas.

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Figure 1.Premia in Dec. Corn Fut., Normal Crops,1975-1996, May vs. Early Nov. Price

t test = significant at 2.69%

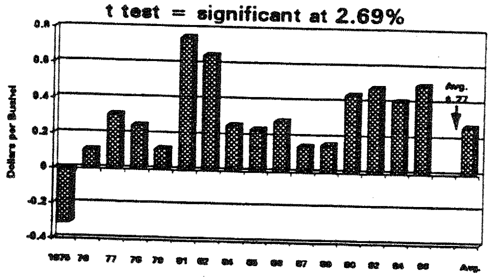

Figure 2. Premia in Nov. Soy Fut., Normal Crops, 1975-1996, 3rd May vs. Mid-Oct.

t test = significant at 1.9%

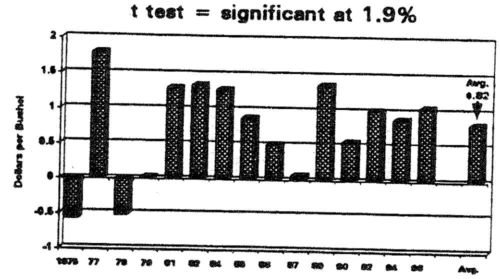

Figure 3. Premia in Dec. Corn Futures, All Short Crops, 1975-1996, Early July to Nov.

t test = not signif. @ 61% level

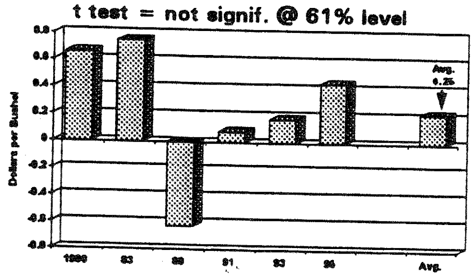

Figure 4. Premia in Nov. Soy Futures Price, Short Crops, 1976-1993, Early July to Mid-October

t test = 94%, not significant

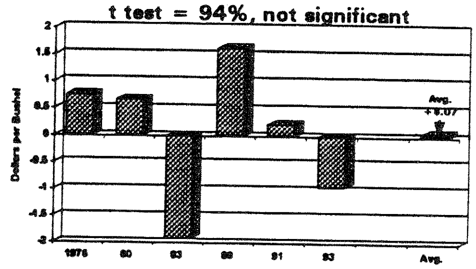

Figure 5. Premia, Late Feb. vs. Early Nov. in Dec. Corn After Short Crops, 1975-1996

t test = significant at 6.4%

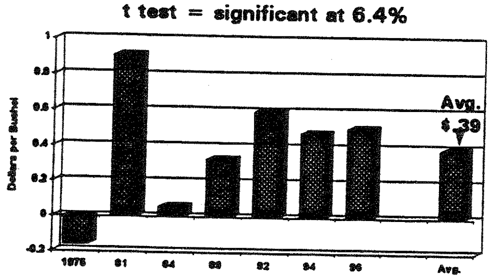

Figure 6. Premia, Late Feb. vs. Mid-Oct. in Nov. Soybeans After Short Crops, 1975-96

t test = significant at 1.81%

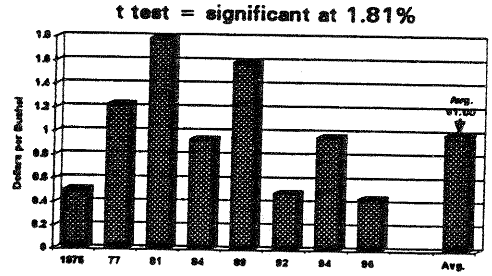

Figure 7. Weekly Average, Dec. Corn Futures Price, Normal Crop Years, 1975-1994

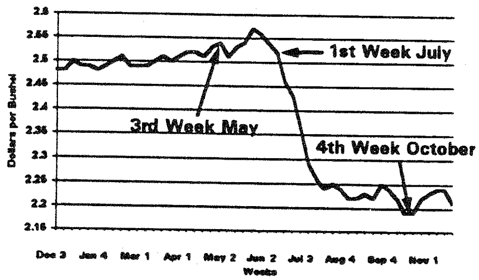

Figure 8. Weekly Avg. Nov. Soybean Futures Price, Normal Crops, 1976-1994

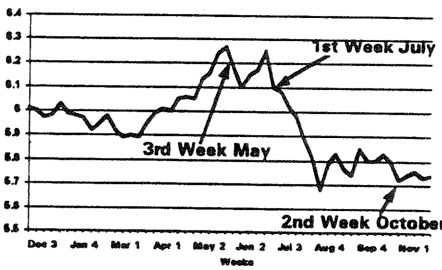

Figure 9.Weekly Avg. Dec. Corn Fut. Price, Short Crop Years, 1975-1994

Occur 24% of Years

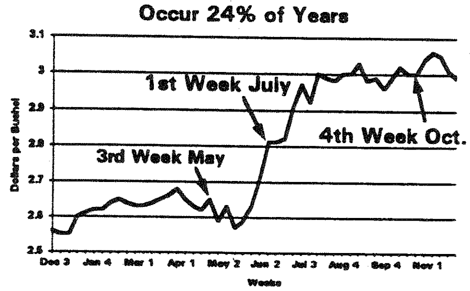

Figure 10.Weekly Avg. Nov. Soybean Futures Price, Short Crops, 1976-1994

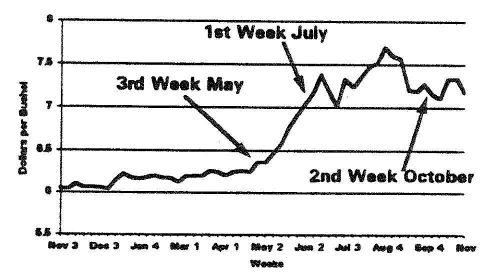

Figure 11.Weekly Avg. Dec. Corn Futures Price, Year After Short Crops, 1975-1994

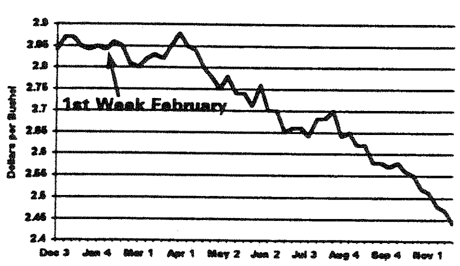

Figure 12.Weekly Avg. Nov. Soybean Futures Price After Short Crops, 1976-1994